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2

FIFTH QUARTERLY R AND D STATUS REPORT

on

THREE-DIMENSIONAL PHOTOCHEMICAL  
MACHINING WITH LASERS

to

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

from

BATTELLE  
Columbus Laboratories  
505 King Avenue  
Columbus, Ohio 43201

November 30, 1983

Sponsored by

Advanced Research Projects Agency (DOD)  
ARPA Order No. 4522, Program Code 2D10

Monitored by AFOSR Under Contract No. F49620-82-C-0077

Effective Date of contract: June 1, 1982  
Contract Expiration Date: May 31, 1984  
Amount of Contract Dollars: \$270,048, including fee  
(\$196,298 obligated to date)

Principal Investigator/Program Manager: Dr. Robert E. Schwerzel  
(614) 424-5637

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MATTHEW J. KEFFER  
Chief, Technical Information Division  
AFSC

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on

## THREE-DIMENSIONAL PHOTOCHEMICAL MACHINING WITH LASERS

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November 30, 1983

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### INTRODUCTION

This document represents Battelle's Fifth Quarterly R and D Status Report to the Air Force Office of Scientific Research on Three-Dimensional Photochemical Machining With Lasers, under Contract No. F49620-82-C-0077, for the period August 1, 1983 through October 31, 1983. (Please note that, although the contract effective date is June 1, 1982, delays in the receipt of a signed contract resulted in an actual start date of August 1, 1982 for the research effort; thus, this report covers the fifth quarter of the actual research effort, as provided in the description of reporting periods in the subject contract.)

Our research efforts during this reporting period have focused on (a) continuing to investigate and characterize the brominated protoporphyrin photoinitiator system we discovered during the second quarter's research, (b) continuing our search for other candidate materials which offer the promise of providing selective photopolymerization when irradiated simultaneously with two laser beams of different colors, but of being inert to the presence of either beam alone, and (c) conducting a detailed

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CHIEF, Columbus Laboratories

study of several porphyrin-based photoinitiator molecules in a different monomer system which has been selected because of its ability to crosslink readily. In particular, we have been studying the behavior of our porphyrin initiators and sensitizers in the monomer, trimethylolpropane-triacrylate (TMPTA). This polymer system crosslinks and hardens very efficiently upon two-beam irradiation using several of our novel brominated porphyrin photoinitiators, as well as with a two-component photoinitiator system consisting of tetraphenylporphyrin and naphthalene sulfonyl chloride. We have observed, however, that single-beam photopolymerization also occurs with this polymer under our irradiation conditions, such that polymer tends to form along one or both beam paths in addition to the intersection point, depending on the specific conditions used. This is clearly not desirable, and efforts are now underway to identify conditions that will minimize or eliminate this effect. We anticipate that this problem will be resolved in the context of investigating other polymer systems during the coming months. Our work on the program is continuing to progress well.

Three new motorized translation stages were purchased for this project during the past quarter, as was a new flashlamp for one of our tunable dye lasers (to replace the original, which had broken during an experiment). The translation stages will be programmed into our existing Apple II<sup>tm</sup> computer system to permit precise movement and positioning of the sample in the beam paths under computer control. This construction should be completed within the next few weeks. No travel or visits were made during this reporting period. No major problems or deviations from the program plan have been encountered to date. One new staff member has been added to the project team during this quarter; he is Mr. Dean R. Johnson, who is conducting the research for his Master's Degree thesis (Ohio State University) at Battelle on this project, under the supervision of Dr. Robert E. Schwerzel, the Principal Investigator for this project.

Fiscal Status:

Amount currently provided for the contract: \$196,298

Expenditures and commitments to date (10/31/83): \$159,542

Estimated funds required to complete the work: \$270,048

Estimated date of completion of work: June 30, 1984